314. Graculus pygmæus, Pallas. *Cadel cagam,* Mal.; lit. Sea Crow. *Dia Kawa,* Cing.; lit. Water Kawa. *See Krai,* Dutch. *Graya de Mare,* Port.

—which is also found abundantly on all the inland lakes and rivers of any magnitude.

315. Thalassidroma pelagica, Briss.

The Stormy Petrel is occasionally seen flitting about Colombo roadstead and Galle harbour, particularly after rough weather. It was the last bird that I saw when I quitted the shores of the island, and the last of my "Notes on the Ornithology of Ceylon."

XXVI.—*On the Fertilization of Ferns.* By W. Hofmeister *.

[The author having kindly sent me a copy of the following note, I place it before the readers of the 'Annals' as an important supplement to the notices I have published on the subject in this Journal † and elsewhere. It may be remarked that these statements, recording direct observation of the passage of the spermatozoids down the archegonium, take away the necessity of attributing a conducting power to the mucilaginous contents of the canal of the archegonium, which I speculatively suggested, never having been able to find a spermatozoid in contact with the germinal vesicle.—A. H.]

Numerous examinations of the prothallia of various Ferns in which the embryo was in course of development—examinations made for the purpose of ascertaining the order of formation of the cells of the vegetative organs—have led to my discovery of certain circumstances, hitherto unknown, affording more direct conclusions regarding the process of reproduction in the higher Cryptogamia.

The germinal vesicle originates in the central cell of the archegonium, around a nucleus which appears in the vaulted apex of that cell, without the primitive central nucleus undergoing any essential change. I have already observed and described this phænomenon in the Equisetaceæ (Abhandl. der kön. Sächs. Gesellsch. der Wiss. ii. 172); it holds good of all the vascular Cryptogamia. Before fertilization the germinal vesicle fills scarcely one-third of the central cell. The primary nucleus of

* From the Reports of the Royal Society of Sciences of Saxony, April 22, 1854. Communicated by Arthur Henfrey, F.R.S. &c.

† Ann. Nat. Hist. 2nd Ser. vol. ix. p. 444. Linnæan Transactions, vol. xxi. p. 117.

the latter has vanished by the time when the archegonium is ready for impregnation. In the Ferns, as in the Equisetaceæ, I never found more than one germinal vesicle in each archegonium. In *Salvinia*, on the contrary, there are often two present.

During the formation of the canal traversing the neck of the archegonium, the membrane at the apex of the central cell becomes softened. The spermatozoids which enter this canal make their way through the mucilage filling it, as far as the interior of the central cell, where they move actively round about the germinal vesicle, which is closely adherent to the vaulted apex of the central cell near the internal end of the canal, with its hemispherical free end hanging down in the cavity. In one case, when these spermatozoids had arrived at the central cell of an archegonium of *Aspidium Filix-mas*, the movements lasted for seven minutes from the commencement of the observation. The cessation was accompanied (and probably caused) by the coagulation of the albuminous substance of the fluid contents of the central cell *.

When spermatozoids occurred in the cavity of the central cell,

* This is the place to mention the mode in which I proceeded in my investigations. When Fern spores are thickly sown, a number of the germinating prothallia soon advance far beyond the rest. At the time when the advanced ones have long ceased to produce antheridia, and bear abundance of archegonia (which in closely-tufted erect prothallia are produced on both surfaces, and most abundantly on those having most roots), those which have remained behind in their growth are beginning to be covered with antheridia. If the crop is now kept with little moisture for several weeks and then suddenly abundantly watered, a large number of antheridia and archegonia simultaneously burst. Then, in a few hours afterwards, the surface of the larger prothallia will be found almost covered with moving spermatozoids. I now take such prothallia as exhibit freshly opened archegonia, holding them by one wing between the finger and thumb of the left hand, so that the upper face of the prothallium lies upon the thumb, and with a thin, narrow knife make delicate longitudinal sections perpendicular to the surface of the parenchymatous part of the prothallium. When the cushion-like thickening of the tissue is only $\frac{1}{5}$th of a line thick, after some practice it is not difficult to cut sections not more than $\frac{1}{15}$th of a line broad. If such sections are quickly examined under a power of 200 or 300 diameters, spermatozoids may sometimes be found in the interior of the archegonia which are exposed in their whole length. I once saw two, one close behind the other, in the canal of the archegonium of *Pteris aquilina*, when their movements ceased during the observation; in the same Fern I saw one in motion in the central cell, at the side of the germinal vesicle. In *Asp. Filix-mas* I have seen a spermatozoid moving in the central cell, once more besides the case mentioned in the text; and in this, as well as in *Asplenium septentrionale* and *Filix-fœmina*, I have seen motionless spermatozoids lying beside the partially-developed germinal vesicle. Thus the unequivocal observations of moving spermatozoids in the central cell amount only to three; but these were so clear and distinct as to exclude all possibility of deception.

the entrance of this appeared almost closed by the expansion of the neighbouring cells. This growing up of the internal mouth of the canal evidently followed immediately the entrance of the spermatozoid into the central cell. This is the first phænomenon which gives evidence of the completion of the fertilization, and not, as I formerly assumed (Vergleich. Unters. p. 82), the division of some of the cells immediately surrounding the central cell. The number of these is very variable in unfertilized archegonia of the above-mentioned species. The impregnated germinal vesicle enlarges until it fills the central cell, and then commences its series of divisions (segmentation) which lay the foundation of the various organs of the embryo.

In the Mosses also, the central cell of the archegonium behaves as an embryo-sac. There again the germinal vesicle is found around a nucleus appearing free near (under) the primary nucleus; shortly before the formation of the canal leading through the neck of the archegonium, formed by the dissolution of the axile row of cells of the latter. The new canal lies in the *lower* convexity of the central cell,—its position, and that of the young germinal vesicle, are therefore opposite to those of the same organs in the vascular Cryptogamia. The primary nucleus soon disappears, the germinal vesicle grows considerably, and in the mature archegonium more than half fills the central cell. In the Mosses it mostly floats free in the centre; more rarely it adheres to the side or the upper part of the wall, which, in the archegonium ready for impregnation, softens into a jelly, but does not completely dissolve. In Hepaticæ with very large cavity of the archegonium, such as *Riccia*, *Riella* and *Fossombronia*, the germinal vesicle often rests against some point of the upper convexity, projecting freely into the cavity. I have no doubt that spermatozoids of the Mosses pass the cord of mucus (strongly refracting light) which occupies the axis of the canal of the archegonium and projects a short distance into its expanded portion, that they enter into the latter and come in contact with the outer surface of the germinal vesicle. I am the more confident from having found moving spermatozoids, in *Funaria hygrometrica*, which had penetrated down one-third of the length of the neck of the archegonium. The tenuity of the spermatozoids and the want of transparency in the walls of the archegonium, will be a sufficient apology for the further fate of the spermatozoids not having yet been observed here.